Federal
Planning Bureau
Economic analysis and forecasts

Dynamic microsimulation: what is it (used for in Europe)?

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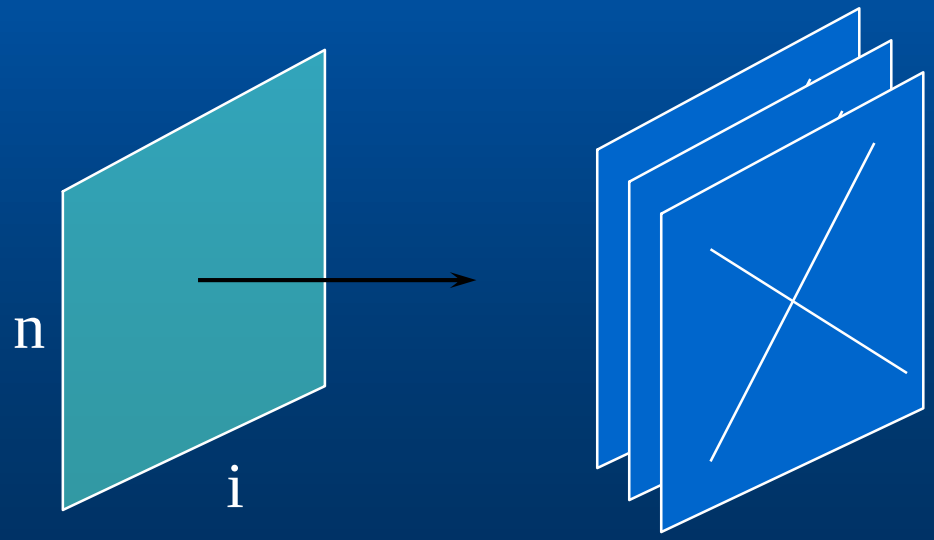
What is microsimulation?

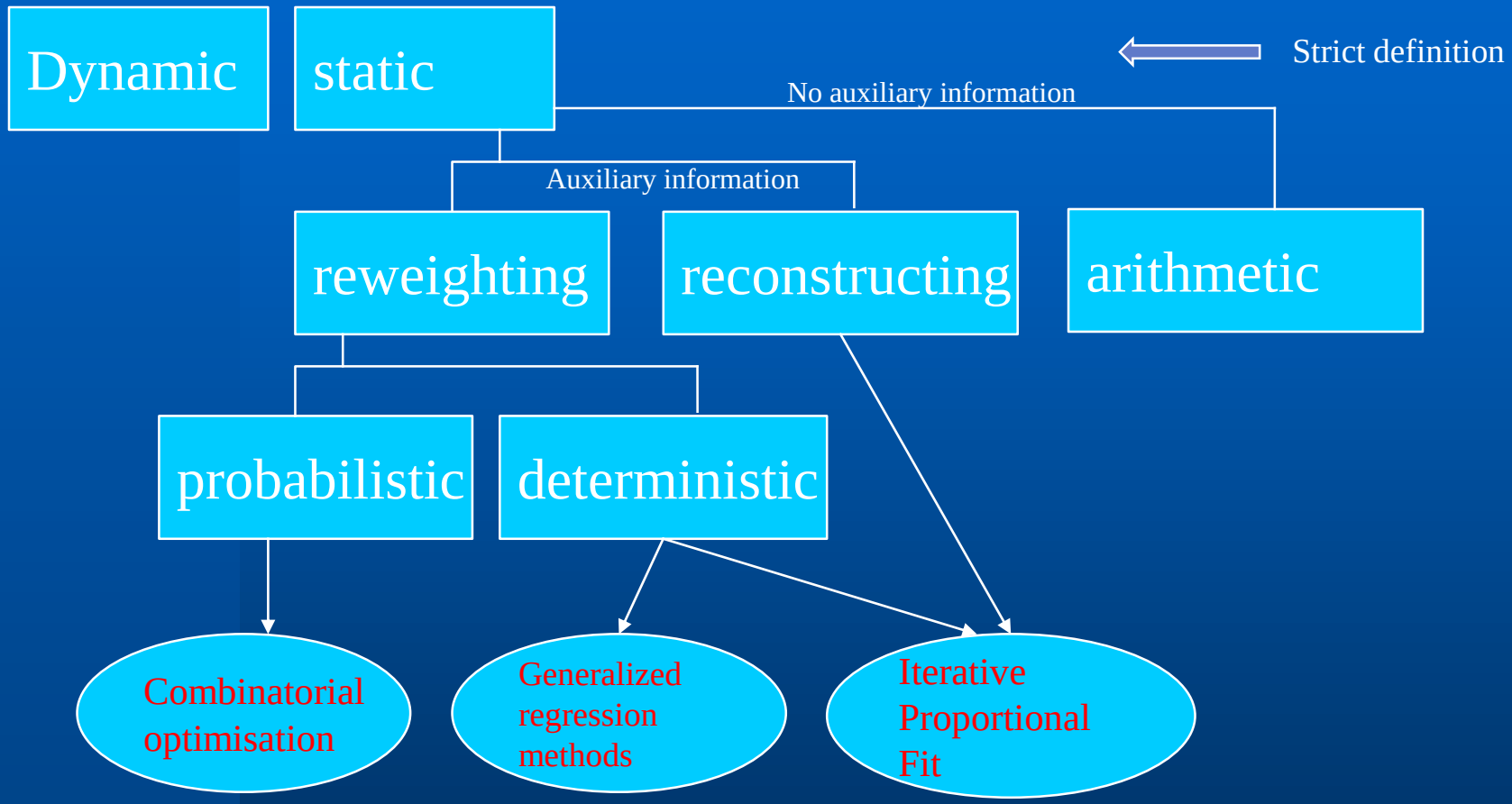
- Look beyond the averages
- Purpose: to impute missing (micro) data
  - Alternative realities at t
  - Prospective scenarios (> t)
- Based on actual or synthetic micro-datasets



What is microsimulation? A classification

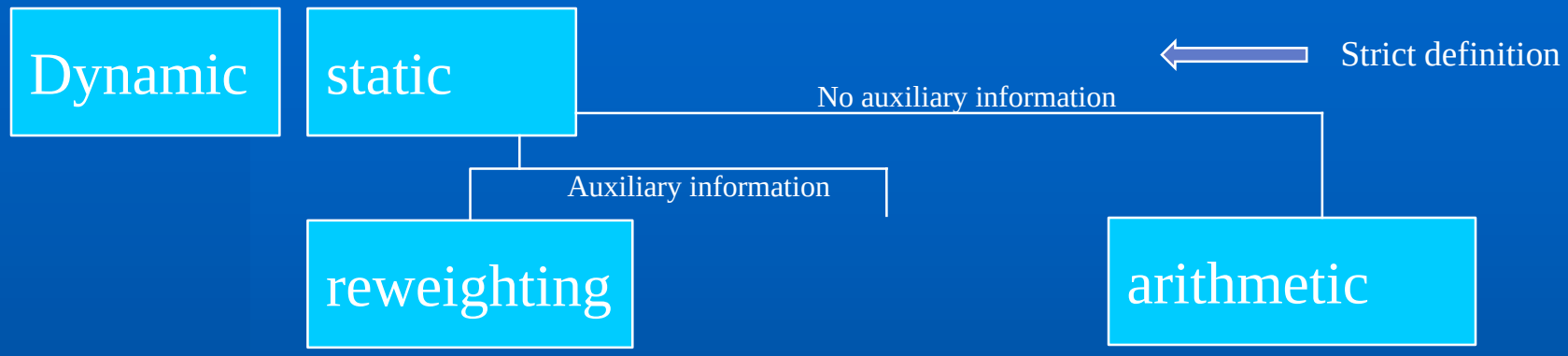
- What is a dynamic microsimulation model?
  - Strict definition: the characteristics of the micro-units change over time
  - broader definition: the model includes some notion of time
- As we will see in the classification of models, models with static ageing are considered "dynamic" only in the broader definition.
- In the literature, usually the strict definition is used. But for the users of the simulation results, the broader definition might sometimes be more relevant.

A classification of microsimulation models



However: if the auxiliary information is prospective, then a static model includes a notion of "time" and thus becomes dynamic in the loose definition.

Some models used in the EU member states

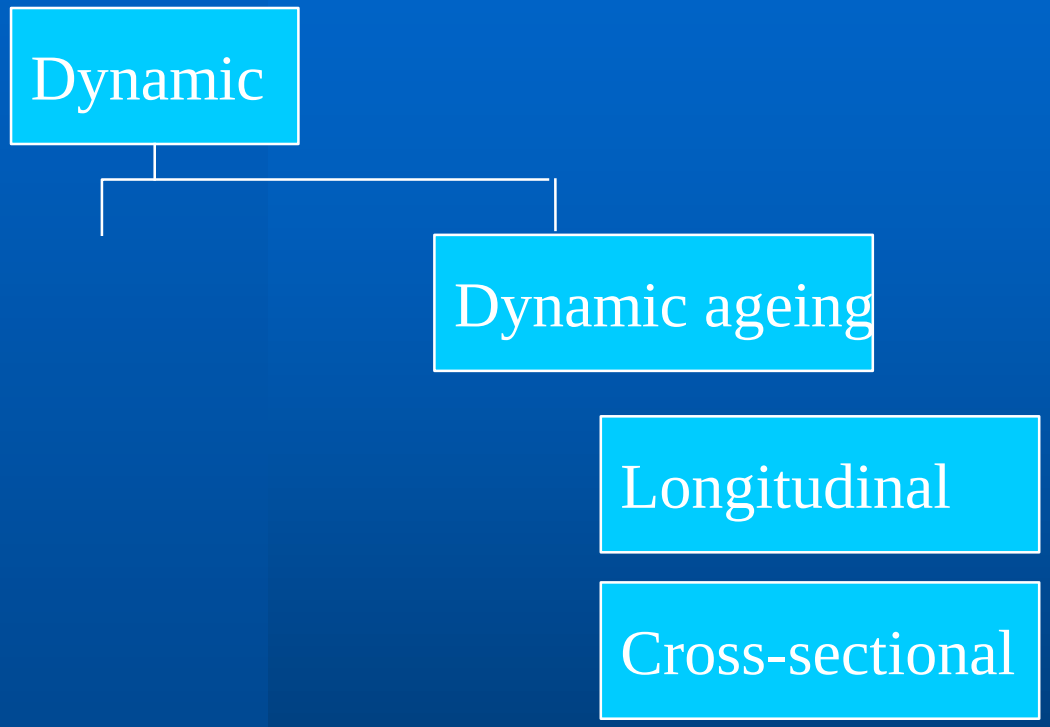


IER-model (Slovenia)
FaMiMod (Italy/Istat)

Euromod

These models are technically static, but dynamic in the loose definition. So some authors (e.g. Colombino, 2015; Dekkers, 2009) would classify them as dynamic.

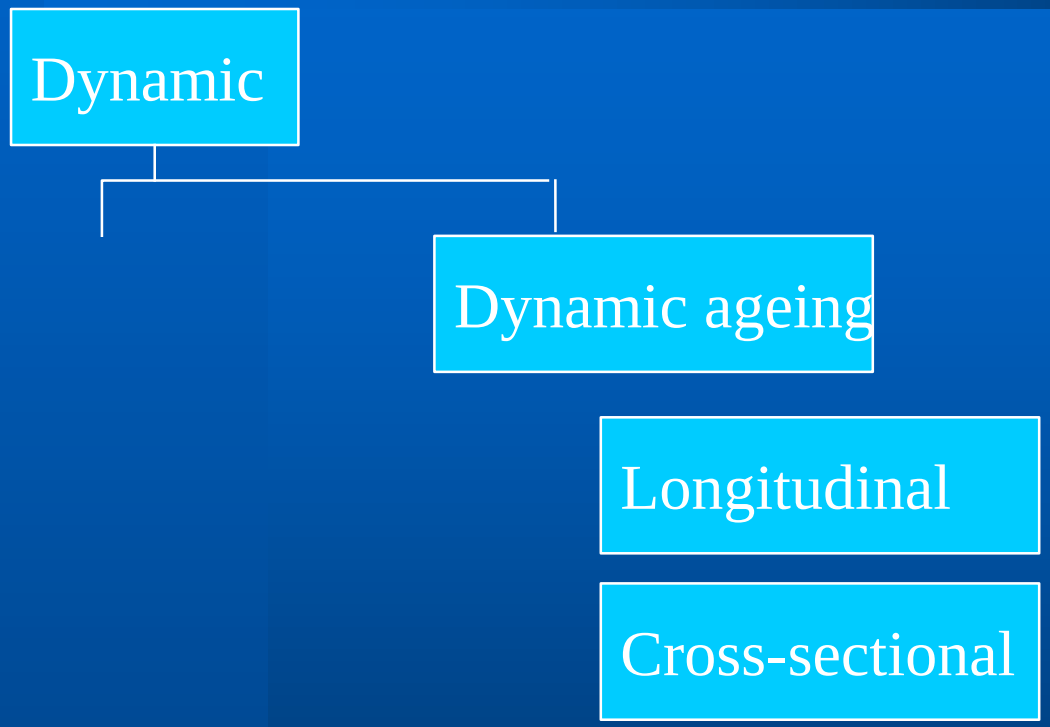
A classification of microsimulation models



Often continuous-time models,
No interaction between objects,
Life-cycle perspective
Application: Demographics, health care
Simulation of hazard functions

Discrete-time models
Various object levels (individuals, Households, firms, …)
Monte-Carlo simulations

A classification of microsimulation models



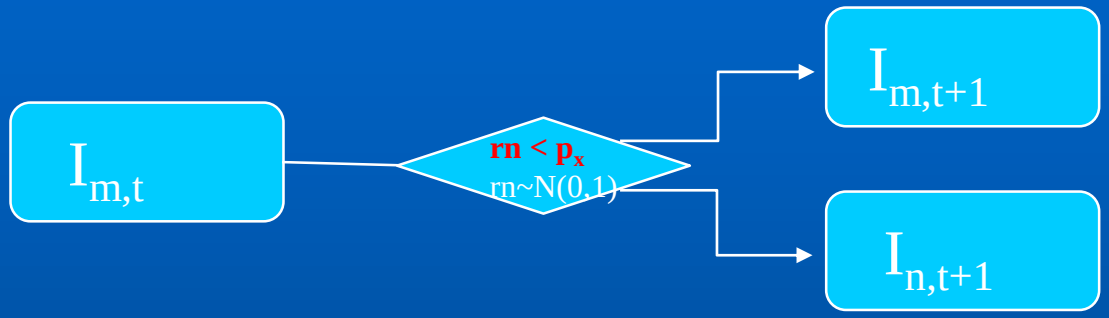
NEMO (Czech Republic)
ZUS (Poland)
SimProVision (Romania)
DyPeS (Spain)

SESIM (Sweden)
Destinie (France)
PENSIM II (UK)
MIDAS (Belgium)
MIDAS (Hungary)
MIDAS (Luxembourg)
ELSI (Finland)
T-DYMM (Italy)

… and DYNAPOR

Basic simulation techniques

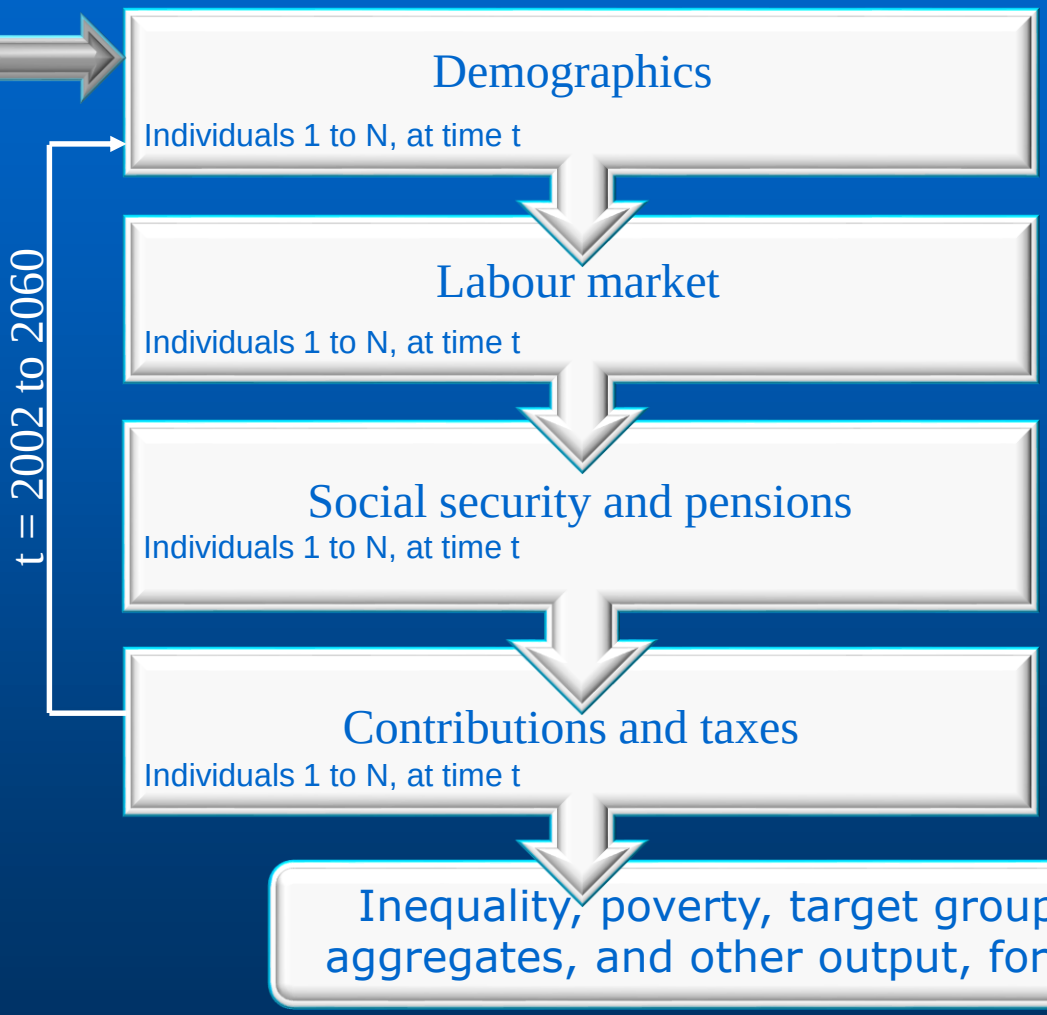
- Basic principle: Monte-Carlo Simulation



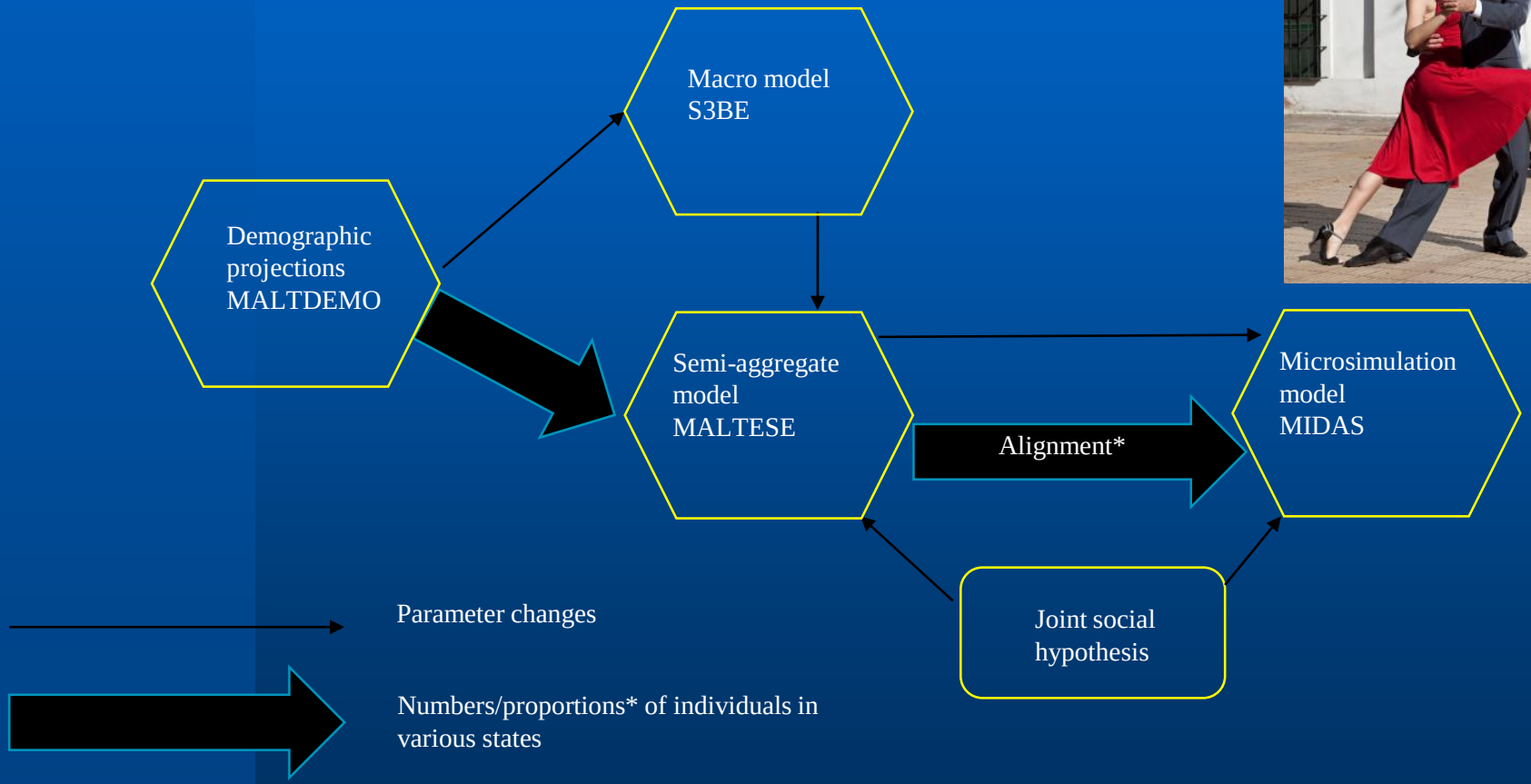
- Matching (e.g. "marriage market")
- Deterministic simulation (e.g. age = age + 1)
- Cloning (e.g. immigrating object = existing object)
- Alignment through sorting

The dynamic microsimulation model MIDAS

Starting dataset
- ✓ 2001
- ✓ Administrative data
- ✓ 300 K individuals, expanded to 2.2K²



Shall we dance? Microsimulation and alignment



An application: what are the consequences of the AWG projections and hypotheses on pension adequacy

- Initiative within the SPC WG-AGE to use dynamic microsimulation models available in member states to simulate prospective developments in (pension) adequacy while taking into account the projections and hypotheses of the AWG.
- Reported in the 2015 PAR
- A collaboration between Sweden (Ministry of Finance), Hungary (Central Administration of National Pension Insurance; ONYF) and Belgium (Federal Planning Bureau)
- Demonstrate the potential contribution of dynamic microsimulation

Two sides of the same coin

- Financial and social sustainability
  - EPC/AWG
  - SPC/ISG
- SPC and AWG: a clear and recognized need for a joint assessment
  - AWG: prospective indicators of sustainability and the benefit ratio.
  - SPC: 'current' SILC-based indicators of adequacy (financial poverty risk, LWI, multidimensional poverty) and forward-looking theoretical replacement ratios.

Dynamic microsimulation models

- Sweden - SESIM
  - Ministry of Finance, the Economic Affairs Department
  - Produces simulation results for the AWG
  - Starting dataset is 300 K individuals in 1999
  - Includes financial wealth, home ownership, private savings
  - The oldest and most developed model of the three used in this project
- Belgium – MIDAS
  - Federal Planning Bureau
  - Starting dataset is 300K individuals in 2001, expanded to 2.2 K^2 individuals
  - Alignment
- Hungary – MIDAS_HU
  - Central Administration of National Pension Insurance
  - Developed on the basis of MIDAS Belgium
  - Starting dataset is 2 K^2 individuals in 2012
  - The most recent model of the three

Developments in BE, HU, and SE (AWG/msm)

Belgium[1]	2013	2020	2030	2040	2050	2060	Peak year
Population growth rate (in %)	0.7	0.9	0.8	0.7	0.5	0.4	2022
Old-age dependency ratio (65+/15-64)	27.1	29.7	34.7	37.2	37.9	39.9	2060
Labour force participation rate 55-64	44.0	54.0	55.8	56.8	56.3	56.0	2038
Employment rate 55-64	41.6	51.4	53.3	54.3	53.7	53.5	2038
Men: Duration of retirement/average working career	51.5	52.8	55.5	58.3	60.9	63.4	2060
Men: Percentage of adult life spent at retirement	31.1	31.9	33.1	34.2	35.1	36.1	2060
Women: Duration of retirement/average working career	58.9	63.7	66.3	68.9	71.5	73.9	2060
Women: Percentage of adult life spent at retirement	33.7	35.5	36.4	37.3	38.2	38.9	2060
Hungary	2013	2020	2030	2040	2050	2060	Peak year
Population growth rate (in %)	-0.3	-0.1	-0.2	-0.2	-0.2	-0.2	2020
Old-age dependency ratio (65+/15-64)	25.4	31.0	34.4	40.5	47.5	52.6	2060
Labour force participation rate 55-64	41.8	64.8	77.7	76.4	77.9	77.5	2048
Employment rate 55-64	38.6	60.9	73.5	72.5	73.9	73.6	2048
Men: Duration of retirement/average working career	38.5	37.2	39.7	43.0	46.1	49.2	2060
Men: Percentage of adult life spent at retirement	25.7	24.9	26.2	27.8	29.2	30.5	2060
Women: Duration of retirement/average working career	64.4	51.3	51.9	55.2	58.3	61.3	2013
Women: Percentage of adult life spent at retirement	34.7	30.0	30.3	31.6	32.8	34.0	2013
Sweden	2013	2020	2030	2040	2050	2060	Peak year
Population growth rate (in %)	0,9	0,9	0,7	0,6	0,5	0,4	2021
Old-age dependency ratio (65+/15-64)	30,2	33,1	35,7	37,4	37,6	41,5	2060
Labour force participation rate 55-64	77,7	77,1	77,3	78,7	79,2	78,9	2047
Employment rate 55-64	73,7	74,0	74,5	75,8	76,3	76,0	2047
Men: Duration of retirement/average working career	39,3	41,3	43,4	45,4	47,2	49,0	2060
Men: Percentage of adult life spent at retirement	27,1	27,9	28,8	29,8	30,6	31,4	2060
Women: Duration of retirement/average working career	48,6	53,4	55,8	58,1	60,3	62,4	2060
Women: Percentage of adult life spent at retirement	31,2	32,8	33,8	34,7	35,5	36,3	2060

Alignment to AWG projections and hypotheses

- SESIM
  - Population (fertility, mortality, migration)
  - Average unemployment and participation rates, to age groups
  - Earnings per year increase with productivity and average hours worked
  - All parameters follow AWG hypothesis
- MIDAS Belgium and MIDAS Hungary
  - Population (fertility, mortality; *NO immigration or emigration*)
  - All labour market states (working, public/private sector, civil servants) , to age groups and gender
  - All non-working states (unemployment, disabled, pre-retirement), idem
  - Other inactive/retirement as balance entries
  - Earnings per hour increase with productivity (to gender)
  - All parameters follow AWG hypothesis

AWG results

- Projected gross public pension spending by scheme (% of GDP)

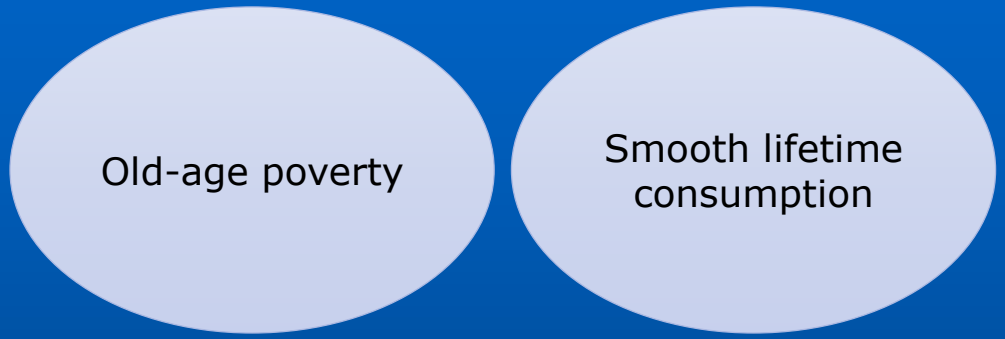
	2013	2020	2030	2040	2050	2060
Sweden	9.3	8.6	8.2	7.8	7.5	7.8
Hungary	11.8	10.1	9.2	9.9	10.9	11.7
Belgium	12.2	13.2	15.3	15.8	15.5	15.7

Source: Country Fiche on Pensions Hungary, Sweden and Belgium; prepared for the AWG projections for age-related public expenditure 2015

- **Main drivers**:
  - Sweden: decreasing benefit ratio and replacement ratio more than counter the increasing dependency ratio.
  - Hungary: countering impacts of increasing dependency ratio and decreasing (early age) coverage ratio. Over the whole period, the replacement rate and benefit ratio continuously decrease.
  - Belgium: increasing dependency ratio – the negative contributions of the coverage ratio and benefit ratio is limited.

The choice of indicators

Holzmann and Hinz (2005)



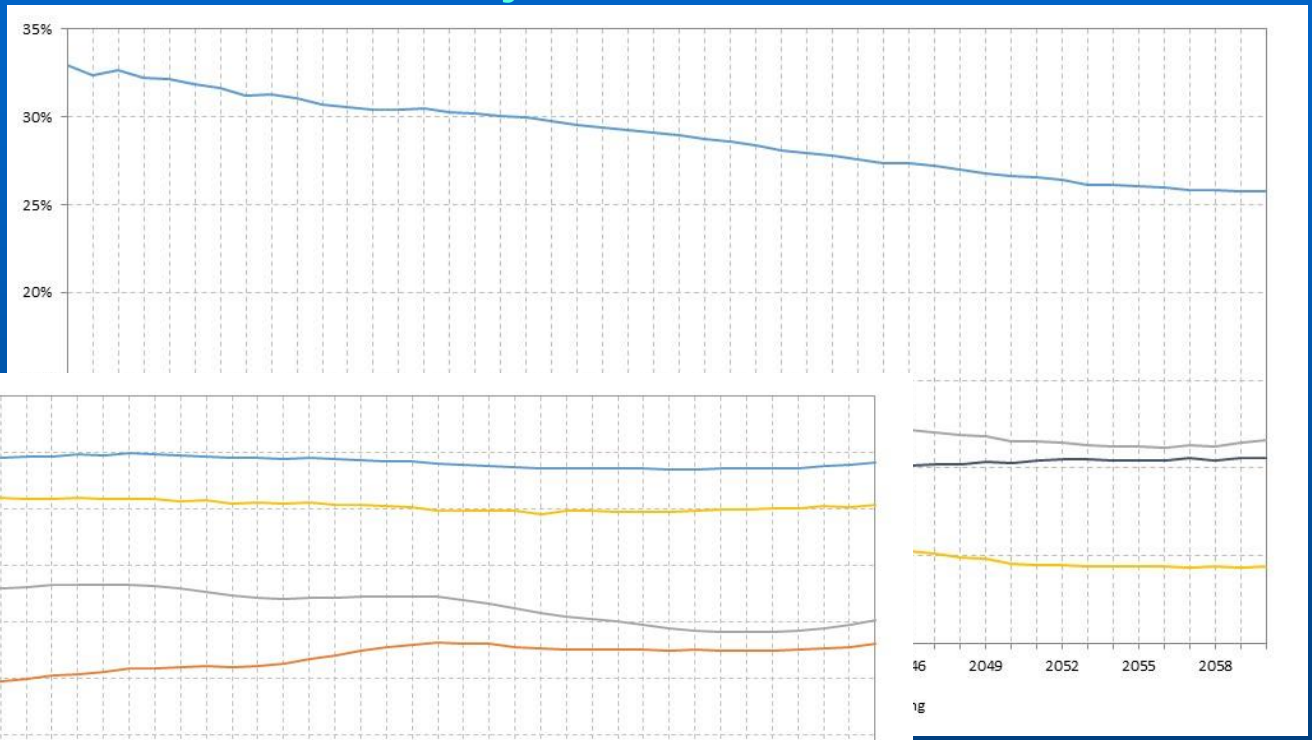
- At-risk-of-poverty-rate
- Gini
- S80/S20
- For the total population, and various subgroups
  - Pensioners: those receiving a pension benefit
  - Elderly (65+)
  - Working population

Results for Hungary

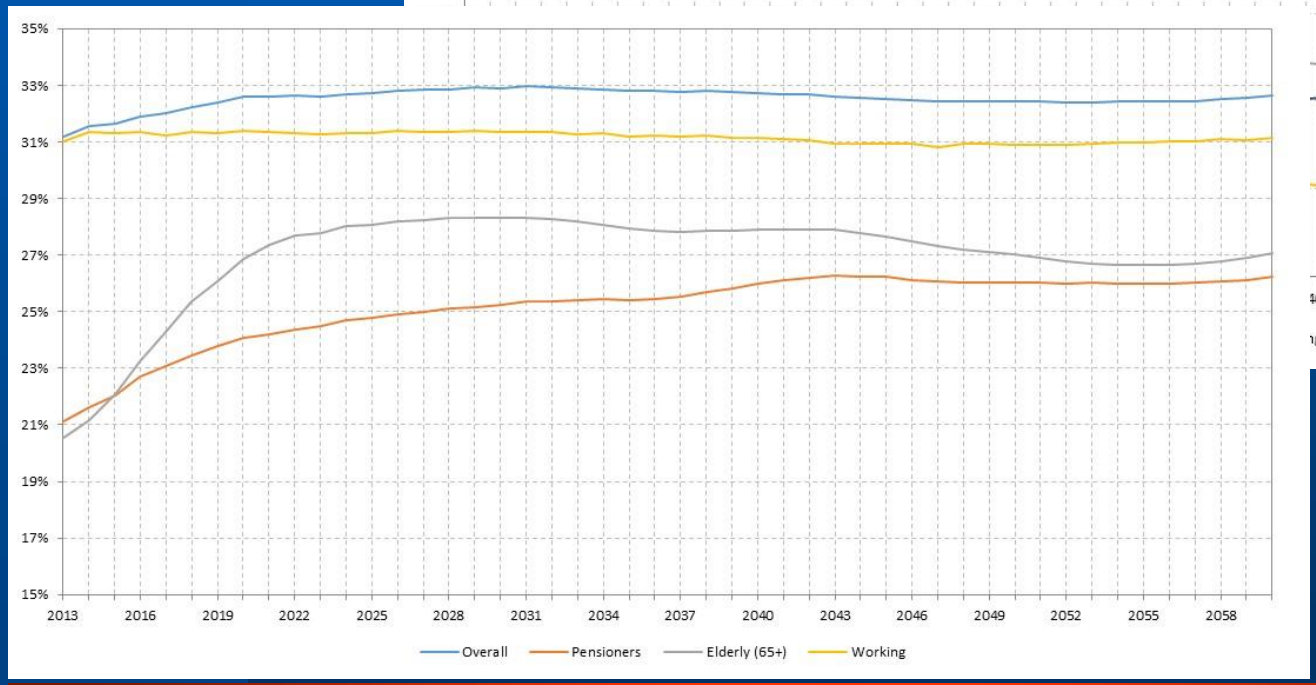
- One-pillar, PAYG, DB pension system
- Benefit a function of contribution years, and average net income after 1987
- Indexed to forecasted inflation
- AROP

Results for Hungary

At Risk of Poverty Rate



Gini

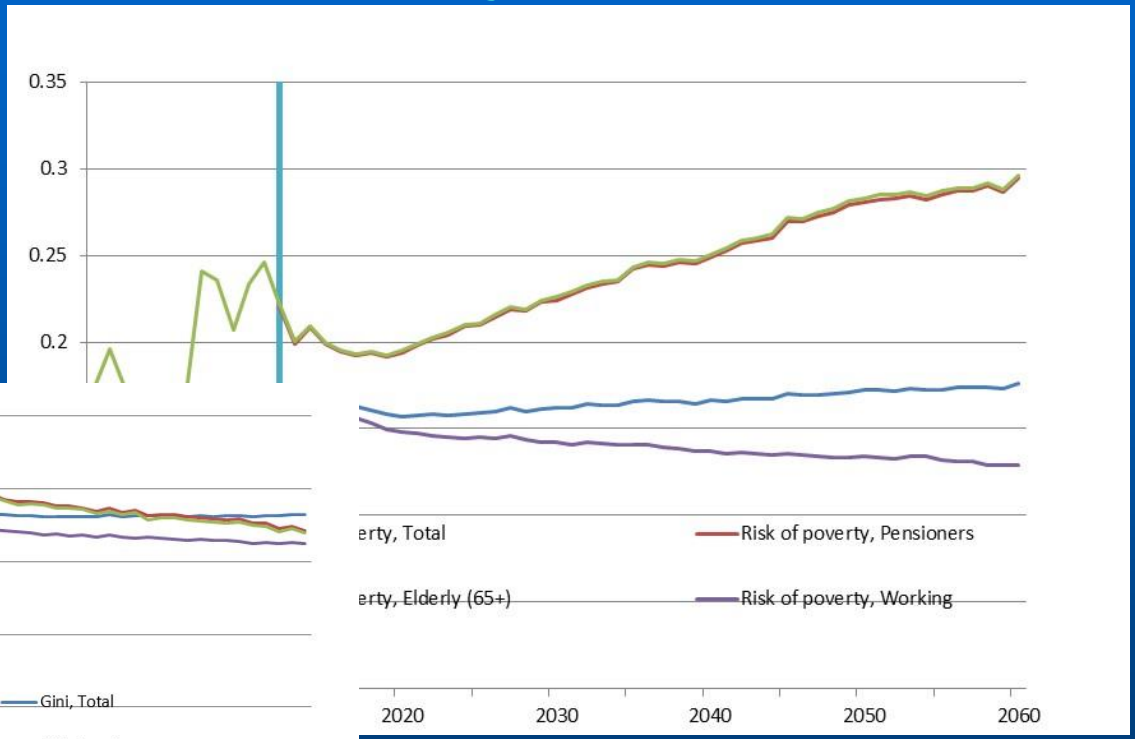


Results for Sweden

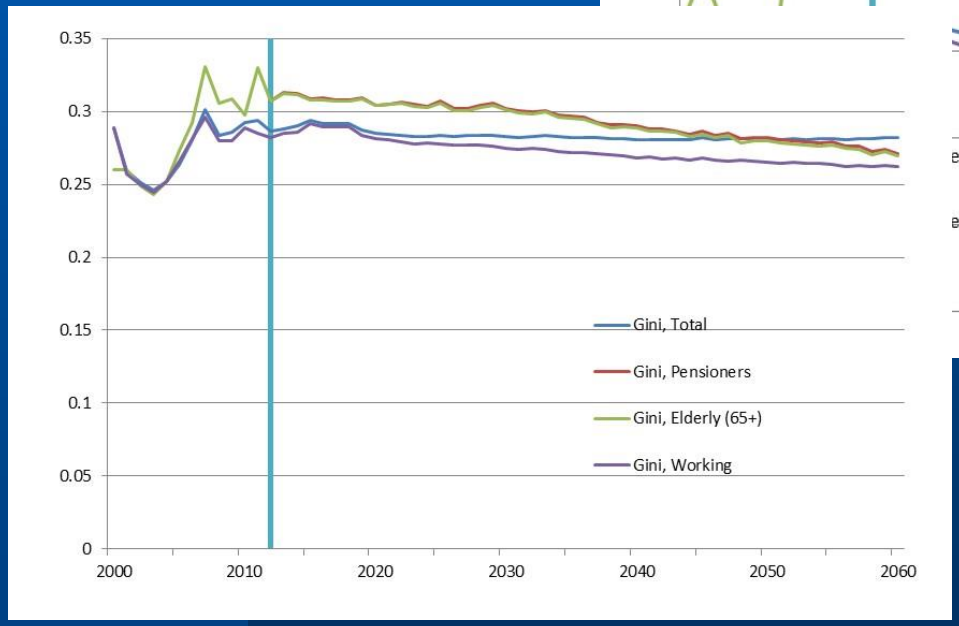
- Swedish pension system
  - Reformed system implemented in 2003
  - Notionally Defined Contribution (PAYG/NDC) with a Defined Contribution system
  - Pension-income-tested minimum benefit
  - Applies to all those born 1938 or later
  - Previous system: flat-rate pension, together with an earnings-related PAYG component
  - The last cohorts with pension rights in the old system will retire around 2020

Results for Sweden

At Risk of Poverty Rate



Gini

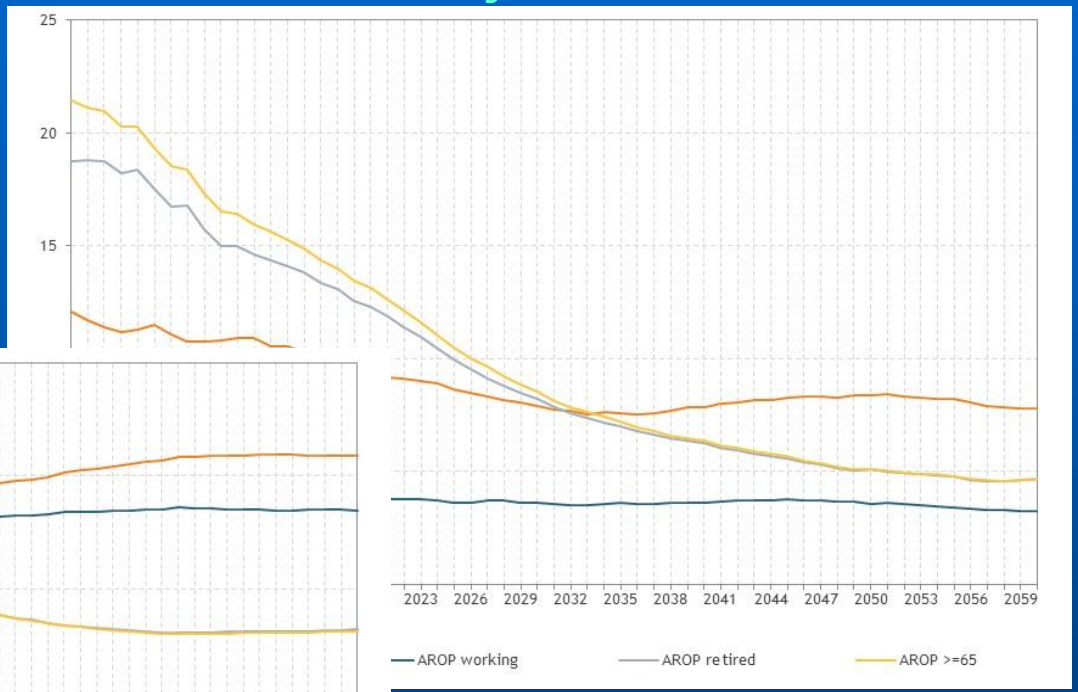


Results for Belgium

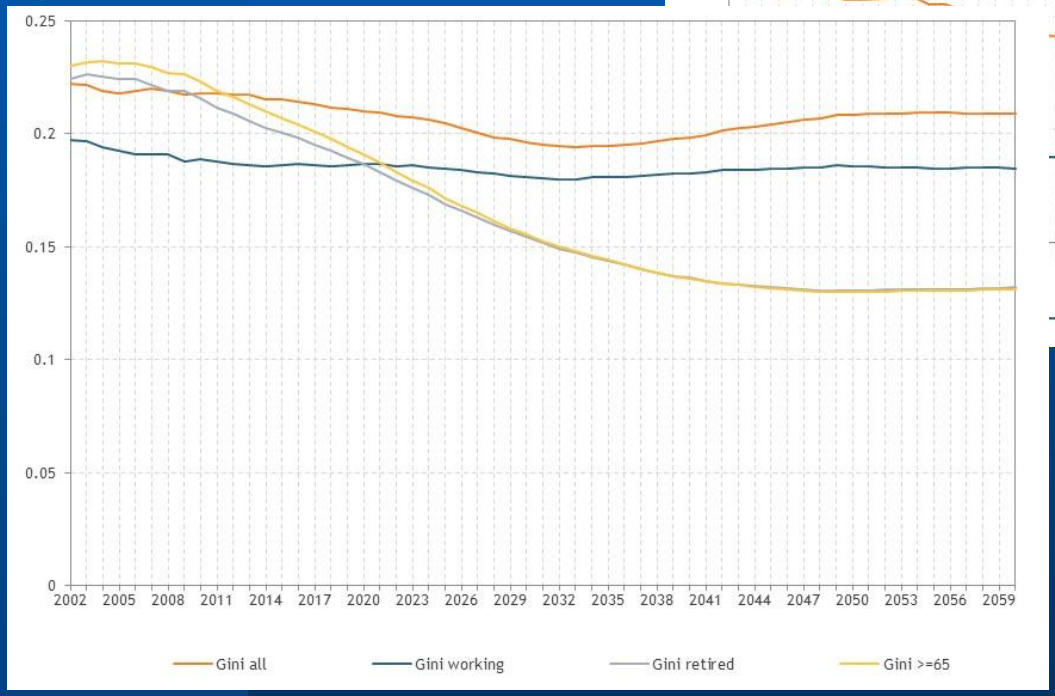
- Three pillars:
  - Mandatory Statutory pension system, DB/PAYG + means-tested 'Guaranteed Income for Elderly Persons
  - Wage earners
  - Civil servants
  - Self-employed
- Retirement age 65, but retirement possible from 62 on, given minimum career length
- Equivalent periods
- Private occupational pension schemes
- Private individual savings and pension schemes
- Indexation regime

Results for Belgium

At Risk of Poverty Rate

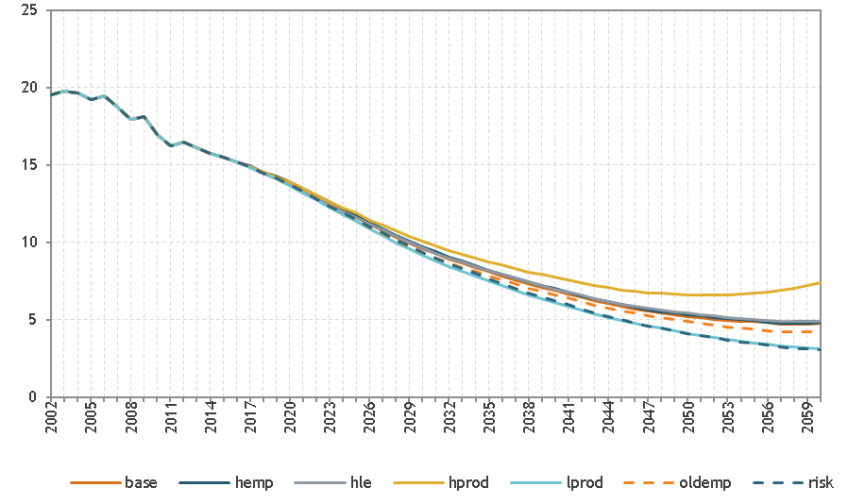


Gini

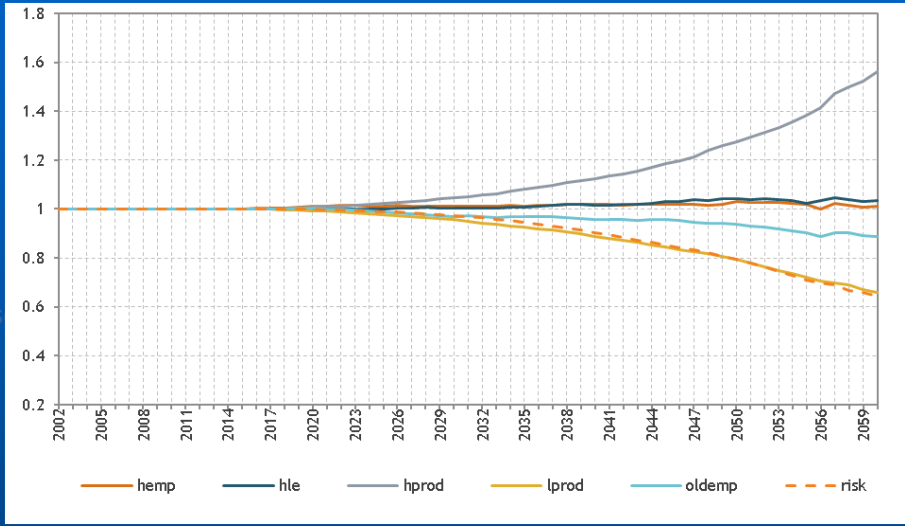


A quick word on the sensitivtiy scenarios…

At Risk of Poverty Rate



Difference with reference scenario



Scenario	Public pension 2013-2016 (%-point difference from base scenario)	AROP	
Higher life expectancy (HLE)	0.7	+, ±	
High productivity (HPROD)	-0.9	++	tradeoff
Low productivity (LPROD)	1.0	--	tradeoff
Higher employment (HEMP)	-0.4		
Higher employment older workers (OLDEMP)	-1.1	--	
Lower TFP rate (RISK)	1.0	--	

An application: what are the consequences of the AWG projections and hypotheses on pension adequacy

- Some conclusions
  - Financial and social sustainability: two sides of a coin
  - This project shows the use of microsimulation in the joint assessment of adequacy and sustainability of pensions.
  - It is remarkable that the results on adequacy complement the results on financial sustainability
- In Sweden, pension expenditures as a percentage of GDP decline; AROP increases.
- In Belgium, pension expenditures to GDP increase, while AROP decreases.
- Increasing the employment of older workers results a reduction of the budgetary costs of ageing, while reducing the poverty risk among the elderly.

A brief look to the future

- The output of this project was reported in the 2015 PAR
- Reactions were quite positive
- DG EMPL and the president of the SPC WG-AGE have explicitly stated in their ambitions for the 2018 PAR
  - "*…it would be important to try to extend the group of countries volunteering to develop projections with the help of micro-simulation methodologies*" (Synopsis of the 2018 PAR, §4.1.1., page 6)

A brief look to the future

- Belgium has again offered to take the lead in this exercise for the 2018 PAR
  - Hungary has formally agreed to participate
  - Other, informal, invitations have been sent out to countries with comparable models.
    - Sweden, France, UK, Luxembourg.
- The members of the SPC WG-AGE have received a invitation via CIRCA.
- Would Portugal be interested in participating?

Thank You For Listening

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Any Questions?